
Article:
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Supplementary Information

Mass balance calculation

To account for the mass loss during the extraction experiment we applied the mass balance calculation of Salvadó et al. (2015) combined with Peter and Sobek (2018). The %OC loss is calculated by applying bulk %C to the pre extraction mass and post extraction %C to the final mass. Comparison by change in raw %C is likely to overestimate the final %C if start and end carbon concentrations are calibrated to the initial mass, as when %C reduces so does the sample mass. Supplementary Equation 1 was devised to determine %OC-Fe loss.

Supplementary Equation 1

$$\Delta C(\%) = \frac{\left(M^{Pre(R)} x\ \%C^{Bulk}\right) - \left(M^{Post(R)} x\ \%C^{Post(R)}\right)}{M^{Pre\ (R)} x\ \%C^{Bulk}} - \frac{\left(M^{Pre(C)} x\ \%C^{Bulk}\right) - \left(M^{Post(C)} x\ \%C^{Post(C)}\right)}{M^{Pre\ (C)} x\ \%C^{Bulk}} \times 100$$

$M^{Pre/Post(R/C)}$ = Mass pre/post (R) reduction / (C) control.

$\%C^{Post(R/C)}$ = %C Post reduction/control experiment.

$\%C^{Bulk}$ = %C in the sediment pre extraction (same for control and reduction).

X-Ray Diffraction Analysis

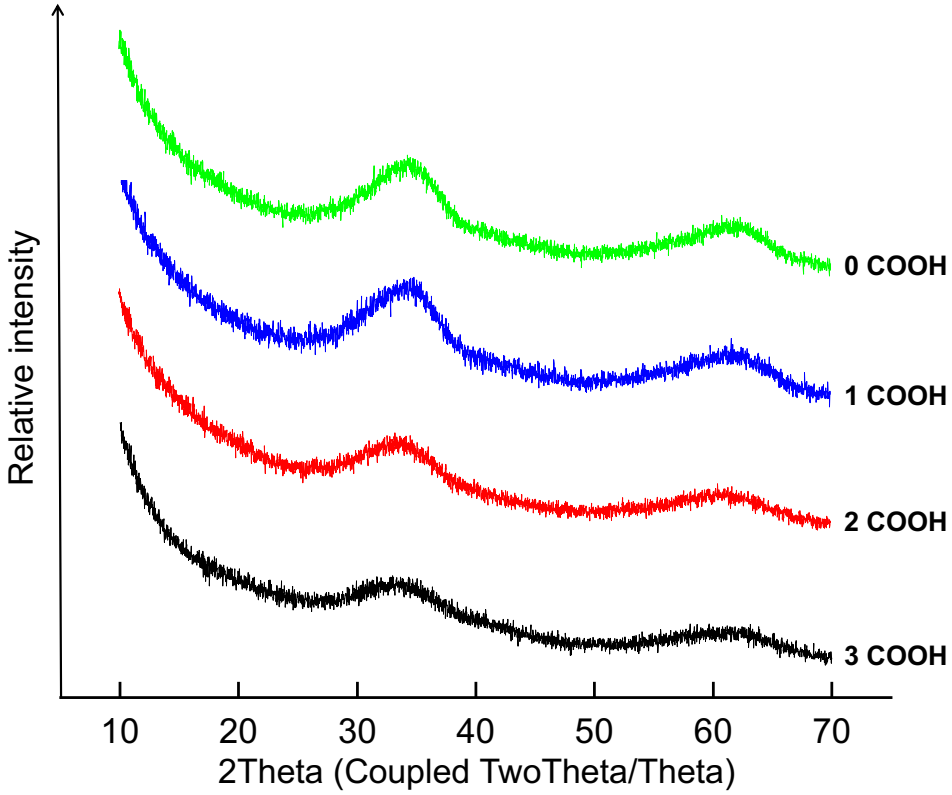

Figure S.1- Stacked XRD of coprecipitates with increasing carboxyl rich organic content.

Statistical Analysis

Ordinary one-way ANOVA

A one-way ANOVA test was conducted for %OC-Fe extraction values (Figure 2) and %Fe extraction values (shown in Figure 4) across the carboxyl range. The one-way ANOVA was applied to these two data sets as a comparative measure of sample means across the groups. The one-way ANOVA is limited by only having the ability to report whether there is a difference in means between two groups. Hence, a Tukey honest significant difference (HSD) test was applied post-hoc to determine the exact groups for which a statistically significant difference in means occurred for at the 99% significance level (**Table S1 and S2).** All analyses were conducted in GraphPad Prism version 8.30, GraphPad Software, La Jolla California USA, www.graphpad.com.

Table S1: Tukey's multiple comparisons test of extracted %OC-Fe for carboxyl coprecipitates.

Comparison	Adjusted P Value	Significant?*
1 COOH vs 2 COOH	<0.0001	Yes
1 COOH vs 3 COOH	<0.0001	Yes
2 COOH vs 3 COOH	0.0001	Yes

*Significance was determined at the 99% significance level.

Table S2- Tukey's multiple comparisons test of extracted %Fe for carboxyl coprecipitates.

Comparison	Adjusted P Value	Significant?*
0 COOH vs 1 COOH	0.0050	Yes
0 COOH vs 2 COOH	<0.0001	Yes
0 COOH vs 3 COOH	<0.0001	Yes
1 COOH vs 2 COOH	<0.0001	Yes
1 COOH vs 3 COOH	<0.0001	Yes
2 COOH vs 3 COOH	0.0019	Yes

*Significance was determined at the 99% significance level.

Determination of %OC-Fe

Table S3 shows the raw data for the reduction and control stages of the CBD treatment which were used as inputs to Equation 1 in order to calculate %OC-Fe as shown in Figures 2 and 3

Table S3- Raw carbon data for determining %OC-Fe.

wt %OC-Fe in sample	Bulk %OC*	Reduction (Δ %OC)	Control (Δ %OC)	%OC-Fe extracted
		1 COOH		
20	0.636	-12.527 (± 21.056)	78.606 (± 11.716)	-91.132 (± 9.340)
30	0.968	17.398 (± 7.741)	95.968 (± 1.162)	-65.189 (± 9.346)
40	0.978	-19.607 (± 2.243)	87.622 (± 9.317)	-107.229(± 11.560)
50	1.357	10.854 (± 9.315)	92.742 (± 4.386)	-81.888 (± 13.702)
		2 COOH		
20	1.681	74.066 (± 5.818)	75.944 (± 1.457)	-1.879 (± 7.275)
30	2.192	71.080 (± 2.150)	70.613 (± 9.976)	0.467 (± 12.126)
40	3.237	63.203 (± 8.030)	78.079 (± 2.245)	-14.876 (± 10.275)
50	3.639	70.423 (± 1.234)	77.892 (± 2.123)	-7.468 (± 3.357)
		3 COOH		
20	2.761	87.043 (± 3.224)	46.620 (± 4.390)	40.423 (± 7.615)
30	4.339	91.764 (± 1.881)	44.503 (± 3.625)	47.260 (± 5.506)
40	5.420	91.628 (± 0.686)	41.114 (± 0.629)	50.514 (± 1.315)
50	6.935	89.602 (± 0.487)	43.036 (± 0.485)	46.566 (± 0.973)

*Bulk %OC refers to the OC content prior to any treatment. Values shown are a mean of duplicates, ± indicates the standard error of the mean (SEM).

References:

Salvadó, J.A. et al., 2015. Organic carbon remobilized from thawing permafrost is resequestered by reactive iron on the Eurasian Arctic Shelf. Geophysical Research Letters, 42(19): 8122-8130,

Peter, S., Sobek, S., 2018. High variability in iron-bound organic carbon among five boreal lake sediments. Biogeochemistry, 139(1): 19-29,